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Influence of Parental Safety Perception on School Travel Independence

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1 Introduction

Independent travel helps children better understand the transport network, develop traffic skills, and gain autonomy. As car use dominates adult travel, promoting children's independent travel can help reduce car dependency, congestion, and emissions. Data from DTU's National Travel Survey (Baescu & Christiansen, 2020) indicate a declining trend in the share of Danish children commuting independently.

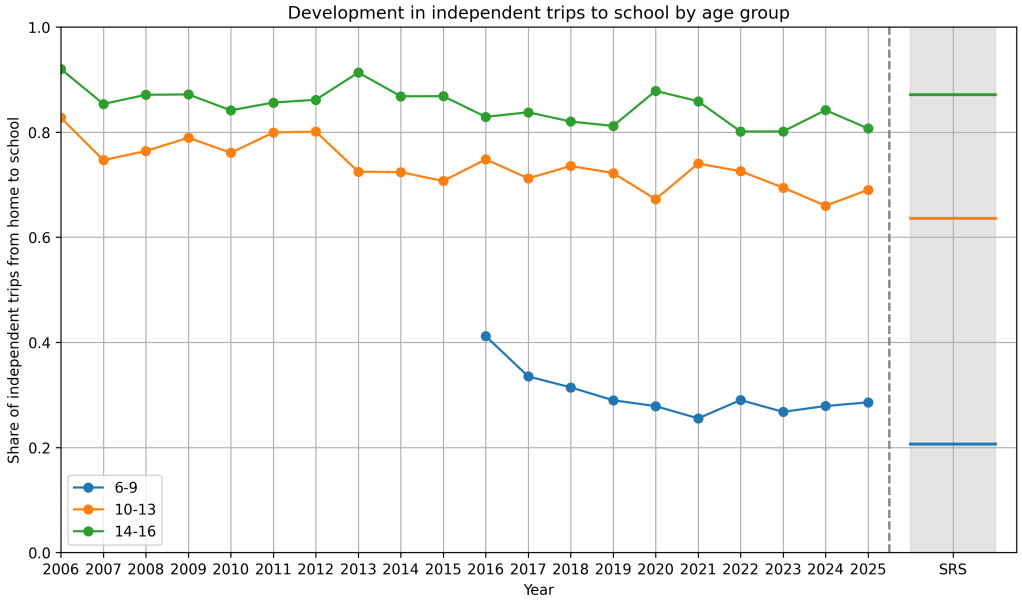

Figure 1: Share of independent trips. National annual development based on National Travel Survey (Baescu & Christiansen, 2020), School Route Survey (SRS) figures on the right are from present study

Perceived safety concerns, especially around traffic, have been shown to be key barriers in transport for children and parents, shaped by road design, infrastructure, traffic levels (Sanders, 2015; Ferenchak & Marshall, 2020; Mehdizadeh et al., 2017), and the behavior of other road users (Lawson et al., 2013; Manton et al., 2016). Local studies indicate that although Danish children generally enjoy cycling and independent travel, parental concerns often restrict it (Municipality of Esbjerg, 2022; Operate, 2022).

This project examines factors influencing children's independence in school travel, drawing on national survey data and newly collected data on parents' safety perceptions. An independent trip is defined as one in which no adult aged 18 or above accompanies or follows the child. We focus on school trips because this travel purpose typically involves the child alone, whereas many other trip purposes include additional family members. In close collaboration with our project partner Trafik i Børnehøjde, the project further investigates the potential of low-cost, locally proposed initiatives implemented at 15 schools across Denmark to shift travel behaviour. Trafik i Børnehøjde has led the development, coordination, and implementation of these local interventions in partnership with schools and local communities.

2 Data

We utilise data from the Danish National Travel Survey (TU) to analyze factors influencing independent travel among schoolchildren in Denmark. TU data has been filtered to include only trips from home to school for children aged 6–16 who travel less than 11 km to school, matching the data collected in the SRS. In addition, the School Route Survey (SRS) was distributed to all parents at participating schools through the digital communication system AULA. We use the same background questions as in the TU survey to enable validation and comparison with the larger, more representative TU sample. Parents report on the most recent trip to school from their home to the child's school. If they have several children at the school, they report on the child who most recently had her birthday. Beside background data, the SRS data includes three indicators of perceived safety related to a (potential) independent trip to school: parents' perceived risk of the child being involved in a traffic accident, parents' perceived risk of the child being subject to a crime, and parents' perception of whether the child would feel unsafe during the trip.

3 Method

To model child probabilitiy of travelling independently we estimate a (mixed-effects) logistic regression. As many questions in SRS are built on TU, these variables can be compared across models. To model TU we use logistic regression

$$logit(P(Y_i = 1|X_i)) = X_i\beta,$$

Y_i is a binary indicator of independent travel, X_i design matrix, β coefficients to be estimated.

Due to dependence within school for SRS, we model a generalized linear mixed model (GLMM)

$$logit(P(Y_{ij} = 1|X_{ij}, \nu_j)) = X_{ij}\beta + Z\nu_j$$

with $\nu_j \sim \mathcal{N}(0, \sigma^2)$ being the school level random effect and $Z_{ij} = 1$, implying a random intercept.

To model the perceived safety indicators, measured on a Likert scale, we estimate an ordinal GLMM. Let Y_{ij} denote an ordinal response

$$logit(P(Y_{ij} \leq k \mid X_{ij}, \nu_j)) = \theta_k - \left(X_{ij}\beta + Z_{ij}\nu_j\right),$$

where k indexes the ordered response categories, θ_k are threshold parameters.

School route initiatives at participating schools

As part of the project, several schools tested small-scale initiatives aimed at encouraging more pupils to travel independently to school. The measures focused on low-cost, locally tailored solutions developed in collaboration with pupils and staff. At participating schools, pupils helped identify and develop small-scale initiatives to promote more independent travel to school. These were evaluated through surveys and input from pupils, parents, and staff during two workshops. The municipality and schools decided which initiatives to maintain. For example, at Tommerup School in Assens, a low-budget trial of a car-free zone led to permanent implementation following positive feed-back.

Data describing traffic conditions around each school

A method to develop variables on traffic conditions around each school is developed together with Rambøll based on TomTom data. These variables describe the average speed and traffic counts on the streets nearby the school. Implementation of this data is still in progress.

4 Results

The survey was so far distributed to 12 schools in Denmark between November 2024 and January 2026, with plans to extend the data collection to 15 schools by late 2026. In addition to school locations, the exact locations of parents' homes were collected to allow for further analysis of neighborhood and weather conditions. While parents generally rate traffic and crime risks below average, they express greater concern about traffic accidents.

4.1 Model for independent travel

Table 1 shows the results of the Logistic regression results for travel independence. Both the TU model and the SRS model reveal consistent and plausible findings. Girls and younger children are less likely to travel independently, and longer distances decrease the likelihood of independent travel. The presence of younger siblings does not affect independent travel, but older siblings appear to have a positive impact, indicating that older siblings sometimes follow their younger siblings to school. TU data indicate that trips with temperatures in the lowest quartile of the sample reduce the probability of independent travel; however, this variable is insignificant for SRS, possibly due to low variability in the data, since the data are clustered on specific days when the survey was distributed to all parents within each school. The other weather variables are insignificant in both models. TU indicates that children whose parents do not own a car are more likely to travel independently, which is intuitive. The same estimate sign is reversed for SRS, though it remains insignificant. Children in rural areas have a significantly lower probability of travelling independently. Interestingly, children living in towns with 200–25,000 inhabitants, as well as those in Aarhus, Odense, and Aalborg, have a higher probability of independent travel compared to children in Copenhagen, all else equal. Parents' perceived risk of their child being involved in a traffic accident, is associated with a lower probability of independent travel, clearly indicating that safety perception of parents affects their childrens travel behaviour.

4.2 Risk perception models

Table 2 includes the estimates for the risk perception models. Parents with smaller children indicate higher perceived risk, while gender is insignificant. This pattern is reversed when we examine perceived risk of crime, where parents of girls, express higher concern. Both variables are very important when it comes to the child feeling unsafe alone, with smaller girls being more unsafe, according to their parents. Improved surroundings and accessibility on the school route significantly reduce parents' perceived risk of traffic accidents and child being unsafe with travelling alone while improved lighting along the route reduce the perceived risk of the child being victims of crime. Interestingly, parents in suburbs and rural areas indicate a significantly lower concern for crime than parents in urban areas. There is no evidence that the low-budget initiatives affect the probability of children travelling independently or any of the safety-perception indicators. However, because different initiatives are implemented at each school, it is possible that some schools experience effects that are not detectable when modelling across all schools combined.

Discussion and conclusion

The analysis shows that parental perceptions of traffic risk are a significant barrier to children's independent travel, underscoring the need for targeted measures that improve both actual and perceived safety. The study also identifies the key factors shaping different types of parental risk perceptions, including traffic risk, risk of crime, and concerns that the child may not feel safe during the trip.

Table 1: Model Estimates: Independent travel

	TU Model			SRS Model		
Variable	Coef.	z	P> |z|	Coef.	z	P> |z|
Intercept	0.68	8.02	0.00	-0.38	-1.01	0.31
Parent's perceived traffic risk				-0.40	-4.71	0.00
Gender of child: female	-0.26	-4.40	0.00	-0.31	-1.93	0.05
Child's age	1.25	35.14	0.00	1.84	15.98	0.00
Number of younger siblings	0.00	0.13	0.90	0.24	2.49	0.01
Number of older siblings	0.20	6.32	0.00	0.60	5.62	0.00
Distance from home to school	-0.52	-15.92	0.00	-0.73	-6.75	0.00
Survey Year	-0.07	-2.36	0.02			
Temperature ≤ 3.6°C	-0.16	-2.17	0.03	-0.49	-2.16	0.03
Temperature ≥ 12.7°C	0.06	0.75	0.45	-0.25	-1.12	0.26
Rain > 0.1 mm	-0.05	-0.56	0.58	0.33	1.30	0.19
Wind ≤ 2.2 m/s	0.09	1.24	0.21	-0.07	-0.36	0.72
Wind ≥ 5 m/s	-0.12	-1.61	0.11	-0.53	-2.09	0.04
Average travel speed (std.)				0.22	1.18	0.24
No car available in household	0.31	2.41	0.02	-0.42	-0.99	0.32
Two or more cars available	-0.08	-1.25	0.21	-0.01	-0.04	0.97
Home in Suburbs (ref: Urban)				0.80	3.04	0.00
Home in Rural (ref: Urban)				0.02	0.05	0.96
Home city size < 200 (ref: Cop)	-0.19	-1.78	0.08			
Home city size = 200–25k (ref: Cop)	0.21	2.62	0.01			
Home city size = 25k–100k (ref: Cop)	0.09	0.92	0.36			
Home city = Ar, Od, Ar (ref: Cop)	0.23	1.96	0.05			
Median income sogn (std.)	0.07	2.12	0.03			
After intervention period				0.06	0.29	0.77
Observations	6594			1186		
Degrees of Freedom	18			19		
Log-Likelihood	-3446.81			-517.61		
School random intercept variance				0.24		

Table 2: Model Estimates: Perceived risk indicators

Variable	Perceived traffic risk	Perceived crime risk	Unsafe travelling alone
Gender of child: female	-0.02	0.40***	0.39***
Child's age	-0.37***	-0.11	-0.71***
Number of younger siblings	0.04	-0.04	-0.03
Number of older siblings	0.02	-0.01	-0.03
Distance from home to school	-0.02	0.16*	0.14*
Home in Suburbs (ref: Urban)	-0.09	-0.34*	-0.11
Home in Rural (ref: Urban)	0.22	-1.00***	0.04
Lighting on roads and paths	-0.01	-0.09**	-0.06
Surroundings along the route	-0.12***	-0.06	-0.11***
Accessibility for the child	-0.22***	0.04	-0.12***
School access conditions	-0.06*	-0.02	-0.04
Bicycle parking conditions	0.01	-0.04	-0.03
After intervention period	0.01	-0.08	0.04
Random intercept variance	0.02	0.13	0.07
Observations	911	908	909
Log-Likelihood	-1967.33	-1968.11	-1883.15
Degrees of freedom	24	24	24

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Overall, the findings highlight the complex interplay between environmental conditions and parental safety perceptions in shaping children's independent travel to school. Future research will extend the SRS to all 15 planned schools and incorporate socioeconomic and built-environment variables.

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